



MATERIAL SPECIFICATION FOR AGGREGATES - SURFACE TREATMENT

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1006.01 SCOPE

This specification covers the requirements for aggregates for use in surface treatment. Quality control and quality assurance procedures and referee protocol are incorporated.

1006.01.01 Significance and Use of Appendices

Appendices are not a mandatory part of this specification unless invoked by the Owner.

Appendix 1006-A is a commentary appendix to provide designers with information on the use of this specification in a Contract.

Appendix 1006-B is an additional information option that is invoked only when referenced in the Contract Documents by the Owner. This appendix contains a form for reporting surface treatment aggregate test data.

Appendix 1006-C is an additional information option that is invoked only when referenced in the Contract Documents by the Owner. This appendix contains a referee testing dispute resolution mechanism.

1006.02 REFERENCES

This specification refers to the following standards, specifications, or publications:

Ontario Provincial Standard Specifications, Material

OPSS 1001 Aggregates - General

Ministry of Transportation Publications

MTO Laboratory Testing Manual:

LS-601	Material Finer than 75 μm Sieve in Mineral Aggregates by Washing
LS-602	Sieve Analysis of Aggregates
LS-604	Relative Density and Absorption of Coarse Aggregate
LS-606	Soundness of Aggregate by Use of Magnesium Sulphate
LS-607	Percent Crushed Particles in Processed Coarse Aggregate
LS-608	Percent Flat and Elongated Particles in Coarse Aggregate
LS-609	Petrographic Analysis of Coarse Aggregate
LS-613	Determination of Insoluble Residue of Carbonate Aggregates
LS-614	Freezing and Thawing of Coarse Aggregate
LS-618	The Resistance of Coarse Aggregate to Degradation by Abrasion in the Micro-Deval Apparatus
LS-619	Resistance of Fine Aggregate to Degradation by Abrasion in the Micro-Deval Apparatus
LS-624	Guidelines for the Use of Control Charts for Construction Aggregates
LS-625	Sampling of Granular Materials
LS-703/704	Liquid Limit, Plastic Limit and Plasticity Index of Soils

1006.03 DEFINITIONS

For the purpose of this specification, the following definitions apply:

Bench means a ledge parallel to stratigraphic bedding that in quarries forms a single level of operation above which rock is excavated from a contiguous face.

Control Chart means a graphical method used to monitor the central tendency and the variability of a material characteristic in order to control production.

Duplicate Samples means two quality assurance samples taken at the same time and location.

Mean means the arithmetic average of a set of data.

Physical Property means an inherent attribute or feature of an aggregate material. Tests are carried out to determine a material's resistance to weathering or degradation or both. Physical properties are generally not affected by aggregate production processes.

Quality Assurance (QA) means a system or series of activities carried out by the Owner to ensure that materials received from the Contractor meet the specified requirements.

Quality Control (QC) means a system or series of activities carried out by the Contractor to ensure that materials supplied to the Owner meet the specified requirements.

Referee Testing means testing by an independent laboratory selected by the Contract Administrator and acceptable to the contractor, the results of which are used for resolving differences between QC and QA testing.

Slag means fused silicate material from the processing of ores and includes air-cooled blast furnace slag, blast furnace slag, copper slag, nickel slag, and steel slag.

1006.04 SUBMISSION AND DESIGN REQUIREMENTS

1006.04.01 Submission of Aggregate Test Data

The Contractor shall have available test results showing complete conformance of the aggregates with this specification. All individual test results shall be submitted to the Contract Administrator 7 Business Days prior to commencing surface treatment.

Test results shall be submitted by either the stockpile or control chart method. All test data forms shall be legible and signed by a testing laboratory representative.

1006.04.01.01 Stockpile Method

Test data shall be obtained from samples taken from stockpiled material intended for use in the work, with the following exceptions:

- a) Where the quantity of aggregate is less than 500 tonnes, aggregate test data obtained within the past 18 months from the same location within the aggregate source of that to be used in the work may be provided.
- b) Where more than one stockpile is being used to supply material, test data shall be submitted for each stockpile.

1006.04.01.02 Control Chart Method

Control charts shall be prepared in accordance with LS-624. Each control chart shall contain information regarding control limits, specification limits, target values, testing frequency, sampling location, and time period over which the testing has taken place.

1006.05 MATERIALS

1006.05.01 Aggregates

1006.05.01.01 General

The requirements of OPSS 1001 shall apply to this specification.

Aggregates shall conform to this specification and be according to the specified MTO Laboratory Testing Manual test number.

Aggregates may be sands, gravels, or quarried rock composed of clean, hard, durable particles.

Aggregates containing slag or composed of slag are not acceptable for use as surface treatment aggregates.

At the discretion of the Contract Administrator, irrespective of compliance or non-compliance with the physical requirements, aggregate may be accepted or rejected on the basis of past field performance. The pavement with which field performance is demonstrated shall have been in a similar environment and application to that in which the aggregate is proposed for use and shall be at least 3 years old, in the case of satisfactory performance. Petrographic study shall be conducted to demonstrate that the aggregate in the original pavement is the same as that under consideration.

1006.05.01.02 Gradation Requirements

Aggregate shall meet the requirements of Table 1.

1006.05.01.03 Physical Property Requirements

The physical requirements of the aggregates shall meet the requirements of Table 2.

1006.07 PRODUCTION

1006.07.01 Aggregate Processing, Handling, and Stockpiling

Aggregates separated during processing, aggregates secured from different sources, and aggregates from the same source but of different gradations shall be placed in individual stockpiles.

Aggregates that have become mixed with foreign matter of any description or aggregates that have become mixed with each other shall not be used and shall be removed from the stockpile immediately. When a change in the character of the materials occurs or when the performance of materials that meet the requirements of this specification is found to be unsatisfactory, use of the materials shall be discontinued. The Contractor may submit additional samples for reassessment and approval by the Contract Administrator.

Once a stockpile has been produced, sampled, and tested for QC under the procedure for Stockpile Method, no further materials may be added to the stockpile. Stockpiles tested under the procedure for Control Chart Method may continue to have materials added provided that sampling and testing show that materials in the stockpile conform to this specification and that the process remains in statistical control.

1006.07.02 Quality Control

1006.07.02.01 General

The Contractor shall be responsible for all QC sampling and testing required to show conformance of the aggregates with this specification.

QC testing for gradation according to LS-602, materials finer than 75 μm by washing of the aggregates according to LS-601, and percent crushed according to LS-607 shall be conducted at a frequency chosen by the Contractor. Test results shall be recorded and the records shall be made available upon request by the Contract Administrator.

1006.07.02.02 Laboratory Requirements

The Contractor shall select all QC laboratories and shall be responsible for all costs associated with the testing for QC requirements.

An acceptable laboratory conducting aggregate tests for physical properties shall be one that holds a current certificate from Canadian Council of Independent Laboratories (CCIL) as Type D for the applicable tests methods and also participates in the annual MTO Proficiency Sample Testing Program for the specific tests.

An acceptable laboratory conducting tests for gradation according to LS-602, materials finer than 75 µm by washing of the aggregates according to LS-601, and percent crushed aggregates according to LS-607 shall be one that holds a current certificate from CCIL as Type C. Testing for gradation and materials finer than 75 µm by washing and percent crushed aggregates shall be conducted by qualified laboratory staff who hold a current certificate from CCIL in aggregate testing.

Equivalent alternate laboratory and technician certifications or laboratory proficiency testing programs may be used to demonstrate similar requirements, provided they are acceptable to the Contract Administrator.

1006.07.02.03 Stockpile Method

Except as noted in the General clause of the Quality Control subsection and as described below, test results demonstrating conformance of the aggregates with the requirements of this specification shall be submitted to the Contract Administrator for each 5,000 tonnes of aggregate produced.

This testing is to be repeated whenever material is produced from a new source or a new bench in a quarry, or whenever a significant change in aggregate production and material occurs that may affect the quality of material.

1006.07.02.04 Control Chart Method

The Contractor shall use a Type 1 control chart as defined in LS-624, for each physical requirement. When the control chart has been established, the minimum frequency of sampling and further testing shall be as follows:

- a) Annually, i.e., obtained within the past twelve months, where the mean value of the physical property is less than or equal to the values given in Table 3 and the Type 1 control chart demonstrates the process to be in statistical control; or
- b) Three times a year spaced evenly throughout the aggregate production season, where the mean value of the property is greater than the values given in Table 3 or the Type 1 control chart demonstrates the process to be out of statistical control.

1006.08 QUALITY ASSURANCE

1006.08.01 General

QA testing may be carried out by the Owner for purposes of ensuring that the aggregates used in the work conform to the physical quality and gradation requirements of this specification.

The Contract Administrator shall be allowed access to all sampling locations and reserves the right to obtain a QA sample at any time with notice to the Contractor.

1006.08.02 Laboratory Requirements

The Contract Administrator shall designate all QA laboratories and shall be responsible for all costs associated with testing for QA requirements.

An acceptable laboratory conducting aggregate tests for physical properties shall be one that holds a current certificate from CCIL as Type D for the applicable tests methods and also participates in the annual MTO Proficiency Sample Testing Program for the specific tests.

An acceptable laboratory conducting tests for gradation according to LS-602, materials finer than 75 μm by washing of the aggregates according to LS-601 and percent crushed aggregates according to LS-607 shall be one that holds a current certificate from CCIL as Type C. Testing for gradation and materials finer than 75 μm by washing and percent crushed aggregates shall be conducted by qualified laboratory staff who hold a current certificate from CCIL in aggregate testing.

Equivalent alternate laboratory and technician certifications or laboratory proficiency testing programs may be used to demonstrate similar requirements provided they are acceptable to the Contract Administrator.

1006.08.03 Sampling

Sampling shall be in accordance with to LS-625.

At least one set of duplicate samples shall be randomly obtained from the stockpile and sealed by the Contractor in the presence of the Contract Administrator or a designated representative. Aggregate samples for testing by the Contract Administrator shall be made available a minimum of three weeks prior to the time of intended use. The stockpiles from which the samples are to be taken shall contain at least 10% of the total quantity of aggregate needed or as specified by the Contract Administrator.

The Contract Administrator shall have access to all sampling locations at any time with notice to the Contractor. The Contractor shall provide new or clean sample bags or containers that are constructed to prevent the loss of any part of the material or contamination or damage to the contents during shipment. The containers shall be sufficiently strong and securely fastened. Metal and cardboard containers are unacceptable. Each container shall hold no more than 30 kg of material. The sample shall be identified both inside and outside of the sample container. Data to be included with the sample shall conform to the requirements of the Sample Data Sheet, as shown in LS-625, Figure 2.

1006.08.03.01 Sample Size

Samples shall provide sufficient mass of material to conduct the necessary gradation and physical quality tests. A minimum field sample mass of 20 kg is required.

1006.08.03.02 Testing and Retention of Samples

The Contract Administrator may elect to carry out testing at the QA laboratory to ensure that the materials conform to the requirements of this specification. One of the duplicate samples shall be randomly selected for testing by the QA laboratory and the remaining sealed sample shall be retained by the QA laboratory for possible referee testing.

1006.08.03.03 Acceptance

QA test results shall be used for acceptance purposes, except where referee testing has been carried out.

When QA test results show that the aggregates meet the requirements of this specification, the material shall be accepted.

When QA test results show that the aggregates do not meet the requirements of this specification, the Contract Administrator shall notify the Contractor that the aggregates, including those in existing stockpiles or in the work, will not be accepted. This notification shall take place in writing within 3 Business Days of receipt of the non-conforming data. The Contractor has the option of either removing

the material from the work or invoking referee testing. At the Contract Administrator's option, the Contractor may request a reduced price in lieu of removal for aggregates that fail to meet the requirements of this specification. Irrespective of the negotiation of a reduced price payment, the warranty provisions of the Contract Documents shall apply.

1006.08.03.04 Referee Testing

When QA test results do not meet the requirements of this specification, the Contractor has the option of invoking referee testing of the test result that fails to meet the requirements. The Contractor shall notify the Contract Administrator of the selected option within 2 Business Days following written notification of acceptable material.

The Contract Administrator shall select a referee testing laboratory acceptable to the Contractor within 3 Business Days following the Contractor's notification to invoke referee testing. Referee test samples shall be delivered to the referee testing laboratory from the QA laboratory by the Contract Administrator. The sealed test sample shall be opened in the presence of the Contractor and the Contract Administrator.

Referee testing shall be carried out in the presence of the Contract Administrator. Where applicable, the referee testing laboratory shall also test a control aggregate sample for each test method required. The Contractor may observe the testing at no cost to the Owner. Comments on the non-conformity of the test methods must be made and corrected at the time of testing. Referee test results shall be binding on both the Owner and the Contractor.

When a referee test result shows that the aggregates do not meet the requirements of this specification, the material represented by the test result, including materials in existing stockpiles or in the work, will be rejected. The Contractor shall remove the material from the work at no cost to the Owner. At the Contract Administrator's option, the Contractor may request a reduced price in lieu of removal for aggregates that fail to meet the requirements of this specification. Irrespective of the negotiation of a reduced price payment, the warranty provisions of the Contract Documents shall apply.

When referee test results show that the surface treatment aggregates meet the requirements of this specification, the material represented by the sample shall be accepted.

The Owner shall be responsible for the cost of referee testing provided that the referee test results show that the aggregates meet the applicable specifications, otherwise the Contractor shall be responsible for the costs.

TABLE 1
Gradation Requirements, LS-602

MTO Sieve Designation	Percent Passing by Mass					
	Class 1 (Note 1)	Class 2	Class 3 (Note 2)	Class 4	Class 5 (Note 1)	Class 6 (Note 3)
19.0 mm	--	100	100	--	--	--
16.0 mm	--	98-100	96-100	--	--	100
13.2 mm	100	75-95	67-86	--	--	96-100
9.5 mm	75-100	50-80	29-52	100	100	50-73
6.7 mm	0-40	--	--	--	40-85	--
4.75 mm	0-10	25-50	0-10	70-100	5-25	0-10
2.36 mm	--	--	--	10-100	0-10	--
1.18 mm	--	10-40	--	5-90	0-5	--
600 µm	--	--	--	3-70	--	--
300 µm	--	2-20	--	2-40	--	--
150 µm	--	2-13	--	0-15	--	--
75 µm	Note 4	2-7	Note 4	0-7	Note 4	Note 4

Notes:

1. Class 1 and Class 5 aggregates shall be washed according to OPSS 1001.
2. Class 3 aggregate has the same gradation requirements as HL4 coarse aggregate.
3. Class 6 aggregate has the same gradation requirements as HL3 coarse aggregate.
4. Class 1, 3, 5, and 6 requirements for percent passing 75 µm are given in Table 2.

**TABLE 2
Physical Requirements**

MTO Laboratory Test	MTO Test No.	Class 1 (Note 1)	Class 2 (Note 1)	Class 3 (Note 1)	Class 4	Class 5 (Note 1)	Class 6 (Note 1)
Loss by Washing, Pass 75 µm sieve, % maximum	LS-601	1.3 (Note 2)	--	1.3 (Note 2)	--	1.3 (Note 2)	1.3 (Note 2)
Absorption, % maximum	LS-604	1.75	--	2.0	--	1.75	1.75
Unconfined Freeze-Thaw Loss, % maximum (Note 3)	LS-614	6	15	6	--	6	6
Percent Crushed, % minimum	LS-607	60	60	60	--	60	60
Flat and Elongated, % maximum	LS-608	20	20	20	--	20	20
Petrographic Examination, % non-carbonate of retained 4.75 mm (minimum)	LS-609	60 (Note 4)	60 (Note 4)	60 (Note 4)	--	60 (Note 4)	60 (Note 4)
Micro-Deval Abrasion (Coarse Aggregate), % loss maximum	LS-618	17	25	17	--	17	17
Micro-Deval Abrasion (Fine Aggregate), % loss maximum	LS-619	--	30	--	25	--	--
Plasticity Index, maximum	LS-704	--	0	--	0	--	--
Alternative Requirement to Unconfined Freeze-Thaw Loss, LS-614							
Magnesium Sulphate Soundness (coarse aggregate), % max loss	LS-606	12	15	12	--	12	12
<p>Notes:</p> <ol style="list-style-type: none"> Class 1, 2, 3, 5, and 6 physical requirements noted above are for the material retained on the 4.75 mm sieve, except for lab test LS-619. When control charts (n > 20) are used for LS-601, the average value shall not exceed the specification maximum, 1.3%, with no single value greater than 1.7%. When quarried rock is used as a source of coarse aggregate, a maximum of 2.0% passing the 75 µm sieve shall be permitted. When control charts (n > 20) are used for LS-601 for quarried rock, the average value shall not exceed the specification maximum, 2.0%, with no single value greater than 2.4%. The requirements shall be waived by the Owner when the aggregate meets the alternative unconfined freeze-thaw requirements (LS-614). This requirement is applicable to surface course aggregates in the area to the north and west of a boundary defined as follows: The north shore of Lake Superior, the north shore of the St. Mary's River, the south shore of St. Joseph's Island, the north shore of Lake Huron easterly to the north and east shore of Georgian Bay, excluding Manitoulin Island, along the Severn River to Washago and a line easterly passing through Norland, Burnt River, Burleigh Falls, Madoc, and hence easterly along Highway 7 to Perth and northerly along a highway to Calabogie and easterly to Arnprior and the Ottawa River. When the coarse aggregate for surface course is obtained from a gravel pit or quarry containing more than 40% limestone and dolostone in the retained 4.75 mm portion of the coarse aggregate, then blending with aggregate of non-carbonate rock type shall be required. The blend shall be such as to increase the non-carbonate rock type content to 60% minimum of the retained 4.75 mm portion, as determined by petrographic examination, LS-609. When the coarse aggregate for surface treatment is obtained from a non-carbonate source, blending with carbonate rocks, limestone and dolostone, shall not be permitted. The method of blending shall be such as to produce uniform blending and shall be subject to approval by the Owner. In cases of dispute the acid insoluble residue test shall be used, LS-613, with a minimum acid insoluble residue of 60%. 							

TABLE 3
Mean Values for Determination of Control Chart Testing Frequency

Test Method	MTO Test No.	Class 1	Class 2	Class 3	Class 4	Class 5	Class 6
Absorption, %	LS-604	1.3	--	1.5	--	1.3	1.3
Magnesium Sulphate Soundness, % Loss	LS-606	9	11	9	--	9	9
Flat and Elongated Particles, %	LS-608	15	15	15	--	15	15
Petrographic Examination	LS-609	Note 1	Note 1	Note 1	--	Note 1	Note 1
Unconfined Freeze-Thaw, % Loss	LS-614	4	11	4	--	4	4
Micro-Deval Abrasion, Coarse Aggregate, % Loss	LS-618	13	20	13	--	13	13
Micro-Deval Abrasion, Fine Aggregate, % Loss	LS-619	--	24	--	19	--	--
Plasticity Index	LS-704	--	Note 2	--	Note 2	--	--

Notes:

1. For gravel only. Always do three times per year, except where blending to meet the requirements of Note 4 of Table 2, then test daily or every 1,000 tonnes.
2. Always test three times per year.

Appendix 1006-A, Commentary for OPSS 1006, November 2006

Note: This appendix does not form part of the standard specification. It is intended to provide information to the designer on the use of this specification in a contract.

Designer Action/Considerations

Determine whether the table in Appendix 1006-B is to be used by the supplier. If so, it needs to be invoked by reference in the Contract Documents.

Determine whether Appendix 1006-C is required. If so, it needs to be invoked by reference in the Contract Documents. The designer should determine the need for a referee testing clause depending on the size and complexity of the work, whether or not QA testing is to be performed, and the need to have a practical dispute resolution mechanism.

The designer should determine the need for QA testing based on the size, complexity, and desired service life of the work (1006.07.03.02). When QA testing is not specified, consideration should be given to using QC test data for acceptance purposes. In this case the minimum frequency of QC sampling and testing should be specified (1006.07.02.01).

The Contractor is required to obtain all QA samples to remove the argument, in any subsequent dispute, that a poor or biased sample was obtained (1006.07.03).

The requirement for a minimum of 60% non-carbonate aggregate, Table 2, Note 4, in certain parts of the province is based on the following considerations: Carbonate aggregates, due to their low resistance to abrasion, polish easily under traffic and, depending on traffic volume, may result in pavements with relatively differing low frictional properties. In areas of the province with a predominant type of rock, siliceous or carbonate, it has been found that it is best to give consistent frictional properties to pavement surfaces. For instance, it has been found that the use of carbonate aggregates in areas of predominantly siliceous rocks results in lower frictional values than normal for that area and a relatively higher proportion of wet weather skidding accidents in those areas paved with carbonate rocks. In areas of the predominant use of carbonate rocks it has been found that drivers appear to adjust their behaviour to the generally lower frictional properties.

The designer should ensure that the Ontario Provincial Standards General Conditions of Contract and the 100 Series General Specifications are included in the Contract Documents.

Related Ontario Provincial Standard Drawings

None.

Appendix 1006-B

NOTES:

1. Class 1, 2, 3, 5, and 6 physical requirements are for the material retained on the 4.75 mm sieve, except for lab test LS-619.
2. When control charts ($n > 20$) are used for LS-601, the average value shall not exceed the specification maximum, 1.3%, with no single value greater than 1.7%. When quarried rock is used as a source of coarse aggregate, a maximum of 2.0% passing the 75 μm sieve shall be permitted. When control charts ($n > 20$) are used for LS-601 for quarried rock, the average value shall not exceed the specification maximum, 2.0%, with no single value greater than 2.4%.
3. The requirements shall be waived by the Owner when the aggregate meets the alternative unconfined freeze-thaw requirements, LS-614.
4. This requirement is applicable to surface course aggregates in the area to the north and west of a boundary defined as follows:

The north shore of Lake Superior, the north shore of the St. Mary's River, the south Shore of St. Joseph's Island, the north shore of Lake Huron easterly to the north and east shore of Georgian Bay, excluding Manitoulin Island, along the Severn River to Washago and a line easterly passing through Norland, Burnt River, Burleigh Falls, Madoc, and hence easterly along Highway 7 to Perth and northerly along a highway to Calabogie and easterly to Arnprior and the Ottawa River.

When the coarse aggregate for surface course is obtained from a gravel pit or quarry containing more than 40% limestone and dolostone in the retained 4.75 mm portion of the coarse aggregate, then blending with aggregate of non-carbonate rock type shall be required. The blend shall be such as to increase the non-carbonate rock type content to 60% minimum of the retained 4.75 mm portion, as determined by petrographic examination, LS-609. When the coarse aggregate for surface treatment is obtained from a non-carbonate source, blending with carbonate rocks, limestone and dolostone, shall not be permitted. The method of blending shall be such as to produce uniform blending and shall be subject to approval by the Owner.

Appendix 1006-C, Additional Information for OPSS 1006, November 2006

Note: This appendix is not a mandatory part of the standard specification. However, it is written in mandatory language to permit invoking it by reference in the Contract Documents.

When a referee test result shows that the aggregates do not meet the requirements of this specification, the material represented by the test result, including materials in existing stockpiles or in the work, will not be accepted. At the Contract Administrator's option, the Contractor may request a reduced price in lieu of removal provided that: the referee test values do not exceed the requirement for the Unconfined Freeze-Thaw, LS-614, or Magnesium Sulphate Soundness, LS-606, value by more than 25% of the specified value; or exceed the requirement for the Micro-Deval Abrasion, LS-618, value by more than 10% of the specified value. For example, where the Magnesium Sulphate requirement value is 12, a reduced payment may be negotiated provided the referee test value does not exceed 15. The minimum price reduction will be 15% of the tender price for the item.